PEDAGOGY

Ostapovych N.V.

Contemporary Associative Methods in Teaching Medical and Biological Physics

Ostapovych Nataliya Volodymyrivna, post-graduate
National Olexandr Bohomolets Medical University, Kiev, Ukraine

Abstract. The article deals with the problem of using the interactive technologies in associative forming of basic physical notions by the medicine students. It enables to depart from the traditional character of the lecture, aiming solely at the mechanical reproduction. The elaborated associative method of teaching has been introduced and approved by lecturing on the topic "Electrography and Electric Conductivity of Tissues and Organs". In order to activate the visual memorization the author recommended to suggest the associations for the pictures (Leonardo da Vinci golden ratio, Einthoven triangle, picture of the vector-cardiogram, traffic lights with the black pillar to remember the order of the electrode position etc). The applicability of the methods of an associative flower, bush, cluster and "agrimony" in lecturing courses has been proved. The specific development of prospect-plans of lectures in a certain range of medical and biological physics classes in medical universities and the practical approbation of their associative component has been defined as the subject of our further research.

Keywords: *medical and biological physics; interactive pedagogical technologies; associative method*

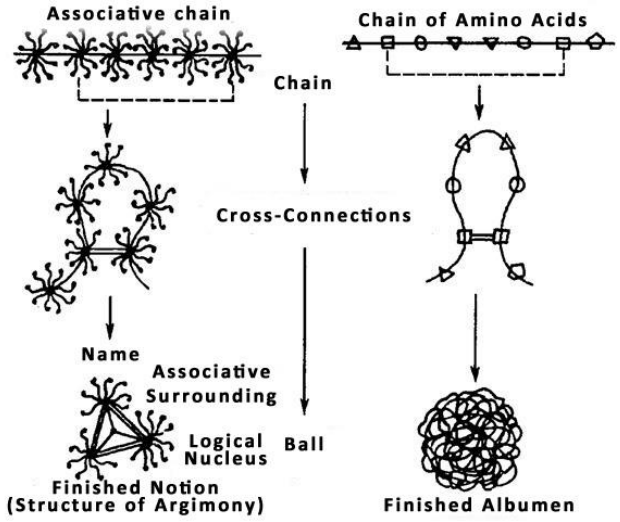
Introduction. Contemporary innovative technologies in education open up a wide selection of the philosophy of teaching and ways of solving practical tasks for the teacher. The interactive methods of education, which aim at significantly increasing the percentage of mastering the material, are getting more and more popular, because they influence not only the consciousness of the student, but also their perception. Among these, the application of the associative technology in education performs a significant role.

The aim of the study. The objective of the research is to analyze the associative method as one of the interactive methods of teaching and its application for the training of future doctors in medical and biological physics. The possibility to use different forms of associative education in teaching medical and biological physics, namely in the "Electrography and Electrical Conductivity of Tissues and Organs" is relevant for our research.

Results and discussion. It is well known, that organs, tissues, cells and their components are electrically active, i.e. the process of their function is connected with the appearance in their environment of the variable electric field. Its characteristics (difference of potentials, tension, caused currents etc.) can be registered. The obtained information can be used for diagnostics and in order to research the nature of electrical phenomena in biological tissues. The registration of the difference of potentials between the points of the environment surrounding electrically active tissues is called an electrography and the graph of the temporal dependence of this difference – an electrogram. The electrographic method is used for the clinical diagnostics of the heart (electrocardiography), muscles (electromyography), brain (electroencephalography), retina (electroretinography) etc. In the medical practice among the electrographic methods the method of research of the electric heart's activity – electrocardiography is mostly wide spread. It is founded on the theory, developed in 1912-1924 by the Dutch scientist Einthoven, the founder of the clinical electrocardiography, rewarded the Nobel prize in 1915. With several corrections and supplements this method is successfully used in the clinical cardiology nowadays. It enables to diagnose diseases and illnesses, such as tachy- and bradycardia, myocardial infarction, born heart defects, hazardous influence of different pharmaceutical preparations etc.

The peculiarities of studying natural and mathematic sciences at the medical universities are closely connected with the importance of physics, chemistry and biology as the fundamental general curriculum subjects that form the basis for the future professional competences [4]. The requirement of deep knowledge in fundamental subjects, the large volume of information and its comprehensive understanding, namely when studying the topic "Electrography and Electrical Conductivity of Tissues and Organs" lead to the students' decline in their motivation to memorize the new material. Because when studying this subject matter any student is supposed to keep in memory the material in biology and histology (the structural organization of the membranes), chemistry (the ion nature of the biopotentials), mathematics (vector values and their projections, basic trigonometric formulae) and physics (the electric field, the electric dipole, the potential and the difference of potentials in the electric field of the dipole, principle of superposition, Ohm's law in the differential form etc). In this respect we consider the concept of the "studying zigzag" by the German educator and psychologist Gerhard Schäfer productive. The central metaphor of his theory is a picture of an agrimony. The notions according to Schäfer appear from associations and the associations are the above mentioned agrimonies that spontaneously and randomly connect or associate those things, which sometimes are absolutely not connected with each other. When forming the pattern of associative dynamics Schäfer used the pattern of memory by G. Ebenhaus according to the research of associative tests in psychoanalytic studies (Pic. 1). The further evolution of associative chains is represented by Schäfer in the form of the albumen genesis metaphor. The same way chains of amino acids gradually create cross-connections and structure into the finished albumen, the "agrimonies" of associations create cross-intersections and super-positions, which ultimately create the associative surroundings and a finished concept with the logical nucleus. This method of acquiring knowledge, called "the cognition by zigzag" should be an addition to the generally accepted, directed, immediate learning and cognition. It has to do primarily with

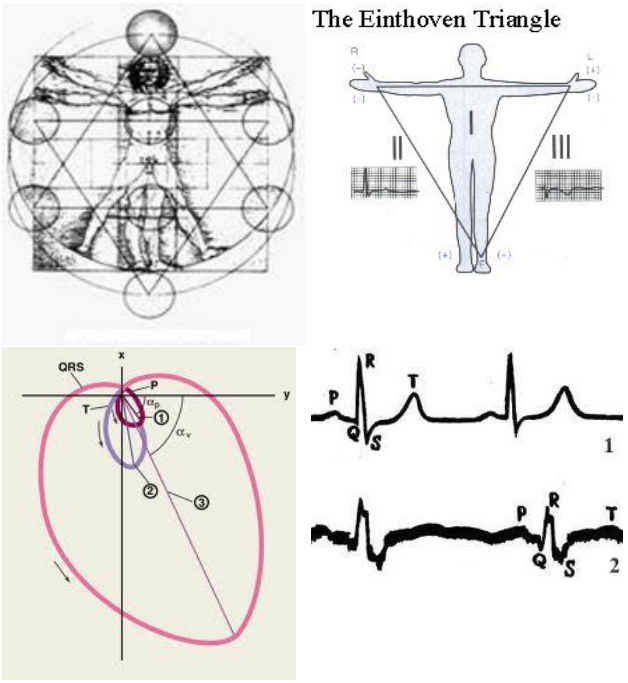
the associative forms of studying the periphery phenomena on the right and left sides of the main target direction of study – expecting that these "chaotic elements" will ultimately be combined into the final significant picture which will be memorized by learners much better than the one-dimensional chain of the directed material provided by the typical "direct" lecturing [6].



Pic.1. Model of the Notion Forming in Metaphors by G. Schäfer (Left side – forming of a notion from the associative chain. Right side – genesis of an albumen.)

Among the interactive methods of teaching we also differentiate the method of an "associative bush". At the beginning of the lesson the lecturer defines with a single word the subject of the work, and the students are supposed to remember everything that is associated with this word. First, the most common associations should be expressed, then – secondary. The lecturer writes down the answers in the form of a certain "bush", which is gradually "growing up". This method, which involves the students' own experience, is conducted face-to-face, it has a high level of the students' interest, and it is practical when providing grounds for the motivation of learning theoretical material, especially at the lecture on "Electrography and Electrical Conductivity of Tissues and Organs". The fundament of the Einthovnes's conception was the theory of the cordial dipole by Waller (1887), that considers the heart as an generator of electricity situated in the volumetric homogeneous conductor (Pic. 2).

It is experimentally proved, that at any fixed moment of time the picture of the equipotential surfaces and power lines on the tissues surrounding the heart is equal to the picture created by the field of a dipole, while the tense section has a negative potential related to the non-tense one. The basic characteristic feature of an electrostatic dipole is its dipole moment $\boldsymbol{P = qL}$ – the vector directed from the negative charge to the positive one. The current dipole can be as an analogue characterized by an electric moment $\boldsymbol{D} = I\boldsymbol{L}$, where I is the power of current, $\boldsymbol{L}$ – vector connecting the negative charge with the positive one. The direction of vector $\boldsymbol{D}$ coincides with the direction of the current in the inner circle of the generator (from the "+" to the "-"). It was the way the notion of an heart dipole was introduced, that was later on transformed to the notion of the Integral Electric Cordial Vector (IECV).



Pic. 2. Heart as an generator of electricity

At the beginning of the lecture the students are offered to write down the associations to the key-notions, both the commonly known ones (dipole, vector, electric field, equipotential surfaces etc.) and the new ones (Einthoven triangle, electrography, diversion system). The most common associations are then to be written by the lecturer on the blackboard.

Table 1. Basic Formulae Characteristic for the Field of the Electrostatic Dipole and the Generator of Current in the Homogenious Conductor

Physical Parameter	Electrostatic Dipole	Einthoven's Model
Field Potential Created by the single Pole	$\varphi = \frac{q}{4\pi\varepsilon\varepsilon_0 r}$	$\varphi = \frac{I\rho}{4\pi r}$
Dipole Moment	$\vec{P} = q\vec{l}$	$\vec{D} = I\vec{l}$
Filed Potential Created by the Dipole at the Distant Point	$\varphi = \frac{P}{4\pi\varepsilon\varepsilon_0 r^2}\cos\alpha$	$\varphi = \frac{\rho D}{4\pi r^2}\cos\alpha$
Integral (Equivalent) Cordial Vector	$\vec{E} = \sum_{i=1}^{n}\vec{P}_i$	$\vec{E} = \sum_{i=1}^{n}\vec{D}_i$
Difference of Potentials between two Equally Distant Points	$\Delta\varphi = \frac{\sin\beta/2}{2\pi\varepsilon\varepsilon_0 r^2}E\cos\alpha$	$\Delta\varphi = \frac{\rho\sin\beta/2}{2\pi r^2}E\cos\alpha$

The next important step for the Einthoven's model has also associative foundations. The activity of the vector on the plane can be described by knowledge of its projections on two non-parallel straight lines at any moment of time. In the same way the activity of the heart can be researched by measurement of the differences of potentials at the corners of the right triangle (Einthoven's triangle) with the IECV in the centre. During the cardiocycle the locality of the tense sections will steadily change, which cause the change of the module and direction of the IECV, i.e. also the differences of potentials in the standard diversions.

In order to activate the visual memorization it is recommended to suggest the associations for the pictures (Leonardo da Vinci golden ratio, Einthoven triangle, picture of the vector-cardiogram, the numbering of the diversion, the flower with the green stem, yellow middle and red petals, which grows from the black soil, beginning from the bottom – right leg – black electrode, left – green, left arm – yellow, right – red one. beginning from the bottom – right leg – black electrode, left – green, left arm – yellow, right – red one, traffic lights with the black pillar to remember the order of the electrode position etc.). The most common individual associations written on the blackboard will become then the stable collective ones, which will lead to the better memorization of the lecture material and better understanding of the subject as a whole. In addition to the "associative bush" the lecturer can use the method of "clustering". The associative clusters can be used during the actualization and comprehension of the knowledge. In order to summarize the lecture, to check and evaluate the acquired knowledge it is useful to practice the informative cluster. The application of the "clustering" method may be done in two ways – the construction of a single-level cluster, or a multilevel cluster. The single-level cluster is a cluster, where all connections in its structure are on one level. In the multilevel cluster each word of the next level becomes the basis for the selection of information [3].

Conclusions. In our opinion if a lecture has an interactive character, paradoxical as it may seem, it is possible primarily by means of the associative method. It enables us to some extent to depart from the traditional character of the lecture, aiming solely at the mechanical reproduction, which we would call the "Socratic scholastics".

We showed the perspectives of associative interactive lecturing methods in order to fulfill several important functions of a lecture – educational, developing, organizing, motivational, hedonistic.

The elaborated associative method of teaching has been introduced and approved by lecturing on the topic "Electrography and Electric Conductivity of Tissues and Organs".

The specific development of prospect-plans of lectures in a certain range of medical and biological physics classes in medical universities and the practical approbation of their associative component will become the subject of our further research.

REFERENCES (TRANSLATED AND TRANSLITERATED)

1. Бусел В.Т. Великий тлумачний словник сучасної української мови / Уклад. і голов. ред. В.Т.Бусел. – К.: Ірпінь: Перун, 2001. – С. 26.

Busel V.T. Velykyy tlumachnyy slovnyk suchasnoyi ukrayins'koyi movy [Great Dictionary of Modern Ukrainian] / Uklad. i holov. red. V.T.Busel. – K.: Irpin': Perun, 2001. – S. 26.

2. Дубравська Д.М. Основи психології: Навч. посібник. – Львів: Світ, 2001. – С.280.

Dubravs'ka D.M. Osnovy psykholohiyi: Navch. Posibnyk [Foundations of Psychology: Teach. Guide]. – L'viv: Svit, 2001. – S. 280.

3. Роговська Ю. Інтерактивні методи навчання на уроках засвоєння синтаксису [Електронний ресурс]. Режим доступу: http://www.naub.org.ua/?p=1024.

Rohovs'ka YU. Interaktyvni metody navchannya na urokakh zasvoyennya syntaksysu [Interactive teaching methods in the classes mastering syntax][Elektronnyy resurs]. Rezhym dostupu: http://www.naub.org.ua/?p=1024.

4. Стучинська. Н.В., Шморгун А.В., Мороз Л.О. Роль і місце фізико-математичних дисциплін у системі медичної освіти: аналіз зарубіжного досвіду // Вісник Чернігівського національного педагогічного університету .Серія: педагогічні науки – 2011. – № 89. – С. 406.

Stuchyns'ka. N.V., Shmorhun A.V., Moroz L.O. Rol' i mistse fizyko-matematychnykh dystsyplin u systemi medychnoyi osvity: analiz zarubizhnoho dosvidu [Role and place of physical and mathematical sciences in the system of medical education: an analysis of foreign experience] // Visnyk Chernihivs'koho natsional'noho pedahohichnoho universytetu .Seriya: pedahohichni nauky – 2011. – № 89. – S. 406.

5. Химинець В.В. Енциклопедія педагогічних технологій та іновацій. – Харків: „Основа", 2011. – С. 283.

Khymynets' V.V. Entsyklopediya pedahohichnykh tekhnolohiy ta inovatsiy [Encyclopedia of educational technology and innovation]. – Kharkiv: "Osnova", 2011. – S. 283.

6.Шефер Г. "Зигзаг" как метод обучения, или может ли из сумбура возникнуть порядок? //Синергетическая парадигма. Многообразие поисков и подходов. М., 2000 – С. 273, 284.

Shefer G. "Zigzag" kak metod obucheniya, ili mozhet li iz sumbura vozniknut' poryadok? ["Zigzag" as a teaching method, or can an order arise from the welter?] //Sinergeticheskaya paradigma. Mnogoobraziye poiskov i podkhodov. M., 2000 – S. 273, 284.

7. Ягоднікова В.В. Інтерактивні форми і методи навчання // Інтерактивні вправи та ігри. – Харків: „Основа", 2010. – С. 107.

Yahodnikova V.V. Interaktyvni formy i metody navchannya [Interactive forms and methods of training] // Interaktyvni vpravy ta ihry. – Kharkiv: "Osnova", 2010. – S. 107.

Остапович Н.В. Современные ассоциативные методы в обучении медицинской и биологической физике

Аннотация. Статья посвящена проблеме использования интерактивных технологий в ассоциативном формировании базовых физических понятий у студентов-медиков. Оно позволяет отойти от традиционного характера лекции, направленного лишь на механическое воспроизведение. Разработанный ассоциативный метод обучения внедрен и апробирован в преподавании темы "Электрография и электрическая проводимость тканей и органов". С целью активирования визуального запоминания автор рекомендует предложить ассоциации к изображениям (золотая пропорция Леонардо да Винчи, треугольник Эйнтховена, картина векторной кардиограммы, светофор на черной стойке для запоминания порядка размещения электродов и.т.д). Обоснована применимость методов ассоциативного цветка, куста, гроздьев и "репейника" в лекционных курсах. Разработка специальных планов-проспектов лекций в определенном наборе учебных занятий по медицинской и биологической физике в медицинских университетах и практическая апробация их ассоциативного компонента определены в качестве предмета будущих исследований.

Ключевые слова: *медицинская и биологическая физика; интерактивные педагогические технологии; ассоциативный метод*